

PATENT

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**ABSTRACT OF THE DISCLOSURE**

A method and apparatus for estimating a porosity and a saturation in a subsurface reservoir. The method includes determining a plurality of mathematical relationships relating a plurality of fundamental physical parameters that govern elastic wave propagation in the subsurface reservoir to the porosity and the saturation in the subsurface reservoir, forward modeling a plurality of seismic attributes using the mathematical relationships to derive a plurality of conditional probability density functions for the seismic attributes, applying a Bayesian inversion to the conditional probability density functions for the seismic attributes to derive a joint probability density function for the porosity and the saturation in the subsurface reservoir, and integrating the joint probability density function for the porosity and the saturation to derive a probability density function for the porosity and a probability density function for the saturation.